THE PAPER
OF
LENDING LIBRARY BOOKS,
WITH SOME REMARKS ON
THEIR BINDINGS,
ILLUSTRATED BY
DIAGRAMS AND PHOTOMICROGRAPHS.

BY
CEDRIC CHIVERS.

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THE PAPER AND BINDING OF RECENT LENDING LIBRARY BOOKS.

BY CEDRIC CHIVERS.

TRADITIONAL METHODS OF BOOKBINDING COMPARATIVELY INEFFECTIVE WITH MODERN BOOKS.

PRACTICAL experience has told us of the deterioration of paper used in lending library books in recent years.

Books are used harder now than they ever were, and the paper composing them is of a worse quality.

Every effort has been made to bind modern books in an effective fashion for public use, but complete success has not been attained with too large a number. In other words, the utmost care exercised in method, workmanship, and materials is not always successful. There has been something elusive and unreliable about the paper of books which has defied the best efforts of the bookbinder. How many books per cent. have ineffective binding, owing to the treacherous qualities of their papers there is no means of determining, but it is evident that many books after careful binding do not serve well.

It is clear that the bookbinder has not comprehended the first thing which should be ascertained before binding a book—that is, the material which he undertook to bind.

THE MATERIAL OF THE BOOK HAS DETERIORATED.

He has followed the traditions of a craft some four hundred years old, and, other things being equal, if the material with which he had to deal had been the same quality, the same satisfactory results should have been obtained. But the paper he has had to bind has been of a very different sort, and he has failed to readapt his methods to the varying qualities of the paper which the modern publishing world has been using. The craft, adapted to and dealing with a material so strong as to withstand strains of 30, 40, or 50 pounds to the inch, finds itself nonplussed and futile having to deal with a material able to withstand only strains of four, three, two, and one pound to the inch.

Doubtless in olden times paper varied in quality, but the worst paper which was used for books likely to be purchased by public libraries before so recent a year as 1890 was of a quality sufficiently good when folded and sewed to have held together for a reasonable service, with the ordinary and traditional methods of bookbinding.

It has been impossible to tell from the appearance and handling of very much of the paper used more recently what qualities it possessed which make it unreliable in a bound form.

BOOKBINDING HAS GENERALLY FAILED TO ADAPT ITSELF TO ALTERED CONDITIONS.

It has become tiresome to the librarian and exasperating to the bookbinder to discover after a book has been bound with every possible care that it has been wrongly bound and should have been dealt with in another fashion. Explanations appear as excuses, and annoyance to all concerned is the certain result. This state of affairs is one which cannot be allowed to continue, and it has become necessary, very late in the day, to understand when binding a book something more than has hitherto been possible of the thing to be bound.

COMPOSITION OF MODERN PAPERS.

One of the first things which would naturally occur to one is to discover the composition of the paper which in the past gave us proper results. To that end I collected from librarians a number of books which had given satisfactory service, and pages from them were sent to a paper technologist for analyses and report.

I have before me a list of twenty books, published by eleven different publishers, with the number of times they were loaned to readers indicated. The number of issues of some of these books is here shown:—134, 140, 152, 181, 214, 259, 274, 282, 290, 300, 334, 483, and 575 times.

REFERENCE № OF BOOK	NUMBER OF TIMES BOOK WAS ISSUED TO READERS	THICKNESS OF PAPER (THOUSANDTHS OF AN INCH)	STRENGTH OF PAPER IN LBS		FIBROUS COMPOSITION				
			MACHINE DIRECTION	CROSS DIRECTION	CHEMICAL WOOD	ESPARTO	RAG	MECHANICAL WOOD	OTHER
33	134	4·3	11·6 lbs	8 lbs	50	38	5	7	..
39	140	6·6	18·0	11·0	50	50	..	..	..
32	152	4·2	17·8	6·0	100	..	..	..	..
43	181	4·2	15·7	7·5	60	34	5	1	..
34	214	5·9	34·3	15·5	45	53	2	..	..
41	259	5·2	18·2	9·2	50	45	5	..	..
42	274	4·6	14·2	7·6	1	98	1	..	..
29	282	4·5	12·5	9·5	..	100	..	..	..
31	290	3·5	13·0	6·6	60	35	2	..	3
36	300	4·0	14·3	7·3	25	70	..	5	..
40	334	5·2	23·2	12·0	15	85	..	..	..
70	483	3·5	12·66	6·0	60	30	10	..	..
71	575	5·75	14·0	8·0	40	58	..	2	..

These figures do not show the relative values of the paper of binding. For the purpose of the lending library they may all be taken as of nearly equal worth.

Their discharge from service depends upon the librarian's notion of cleanliness, and his idea of what makes a decent book for public service.

It would be reasonable to assume that these books could be loaned on an average 200 times.

These selections then were made not to support any theory of book-binding, nor as worthy instances of library economy, but because they prove the paper to have been good for its purpose.

VARYING THICKNESSES OF PAPER.

As to the thickness of the different papers, they varied but little, $\frac{3.8}{1000}$ of an inch being the thinnest, and $\frac{6.6}{1000}$ of an inch being the thickest. This in comparison with a list of 1000 books compiled where the variation is from $\frac{2}{1000}$ of an inch to $\frac{13}{1000}$ of an inch.

Their strength, also, did not vary nearly so much as do more recent papers, the strongest of them breaking at a strain of 15 lbs., and the weakest breaking at a strain of 6 lbs. While the variation between recent books has been as between 40 lbs. and 1 lb. My purpose was, however, to discover the fibrous composition of these papers, and here some very surprising results were shown.

The chief constituents of modern paper are chemical wood, esparto grass, and sometimes a slight intermixture of rag. There are other materials but they, when not actually deleterious, at any rate do not tend to strengthen the paper.

I think it is generally understood that esparto grass alone would not make a strong paper ; that it is used in conjunction with the chemical wood to soften the paper and make it a better printing subject. However that may be, we have the following results of our analyses :

ANALYSIS and COMPARATIVE VALUE OF THEIR FURNISH.

A book showing an issue of 282 times had a fibrous composition 100 per cent. esparto.

Another book came to pieces after being loaned only once. It had a fibrous composition of 2 per cent. chemical wood and 98 per cent. esparto.

Another book, issued 398 times, had 5 per cent. chemical wood, 80 per cent. esparto, and 15 per cent. other mixtures.

A book issued 152 times was composed of 100 per c. chemical wood.

Another book issued 140 times was composed of 50 per cent. chemical wood and 50 per cent. esparto.

Yet another issued 259 times had 50 per cent. chemical wood, 45 per cent. esparto, and 5 per cent. rag.

Still another issued 483 times had 60 per cent. chemical wood, 30 per cent. esparto and 10 per cent. rag.

Another issued 575 times had 40 per cent. chemical wood, 58 per per cent. esparto, and 2 per cent. mechanical wood.

FUTILITY OF THIS CONSIDERATION.

What are we to say to such results as these ? The composition or furnish of the paper appears to have but little to do with its value for the class of book under discussion. It was evident that help for the bookbinders' trouble could not be discovered in this way.

It should be said that nearly all these books were bound in one manner, and that in the manner many hundreds of thousands of books had been bound for public libraries, always keeping the book intact until the paper has given way. The binding of the book issued 483 times is just as good, except as a clean thing, and the condition of its cloth sides, as the binding of the book discarded when worn out after an issue of 140 times.

Before leaving this part of the subject I have to note an interesting and curious fact in regard to a series of popular books much and worthily in demand, but which give us—librarians and bookbinders alike—considerable trouble. In analyzing the paper of these books we discovered that one book is composed of chemical wood 10 per cent. and esparto 90 per cent., while another book of the same series, but a different title, was composed of 90 per cent. chemical wood, 8 per cent. esparto, and 2 per cent. rag. And although the composition of these papers is reversed, we find the number of issues to be very nearly alike, with the advantage, however, on the side of the paper composed of 10 per cent. chemical wood and 90 per cent. esparto.

WHAT WORKS THE MISCHIEF.

From what we know of the value of fibre, we would have thought the second book showing 90 per cent. chemical wood, only 8 per cent. esparto, with 2 per cent. of rag, would be much superior, whereas it was rather inferior. It is clear then that something happens to paper, apart from its fibrous composition, which seriously affects it, from the librarians' and bookbinders' point of view.

I ought to say that many things happen to paper which harmfully affect it for our use, such as printing on it and folding it too soon after manufacture, the manner of its bleaching, etc. But to pursue this inquiry is not germane to our subject. It is a matter beyond our control and effective influence.

The most injurious treatment in recent years to which paper has been subjected is that of overstirring and beating its pulp and so impregnating it with air as to form the featherweight papers, which are among the worst with which we have to deal. This happening does not affect, however, the instance mentioned immediately above.

There is little possibility of making a good and lasting book with some of the papers made from this soufflée of pulp.

Beating or whisking a paper pulp in this fashion fully explains why the fibrous composition has even less to do now than formerly with the mechanical value of paper. The following illustrations, Figs. I to VIII make clear these features of our subject.

FIGURE I.

Figure 1 is a photomicrograph of the edge of a piece of paper (alluded to in the subsequent illustrations as transverse sections) made entirely of linen rag. It has been kindly loaned to me by Mr. R. W. Sindall, author of "An Elementary Manual of Paper Technology." This paper is of too costly a quality,—indeed it is undesirable for many reasons,—for use in such books as those under discussion, but it illustrates the desirable qualities of warp and woof, or inter and across penetration of the fibrous composition of paper, which make for strength. This is hand-made. It is not possible to get such effects with machine-made paper.

Other papers here shown are machine-made and of varied values.

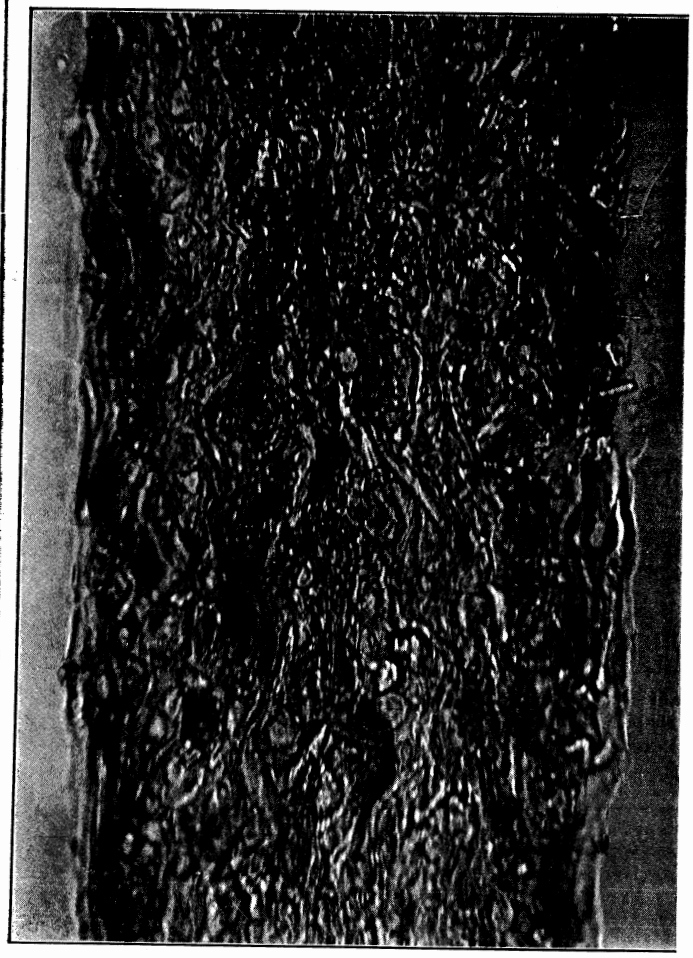


FIG. II. A.
TRANSVERSE SECTION, FIBRES CLOSE, AIR SPACE SMALL.

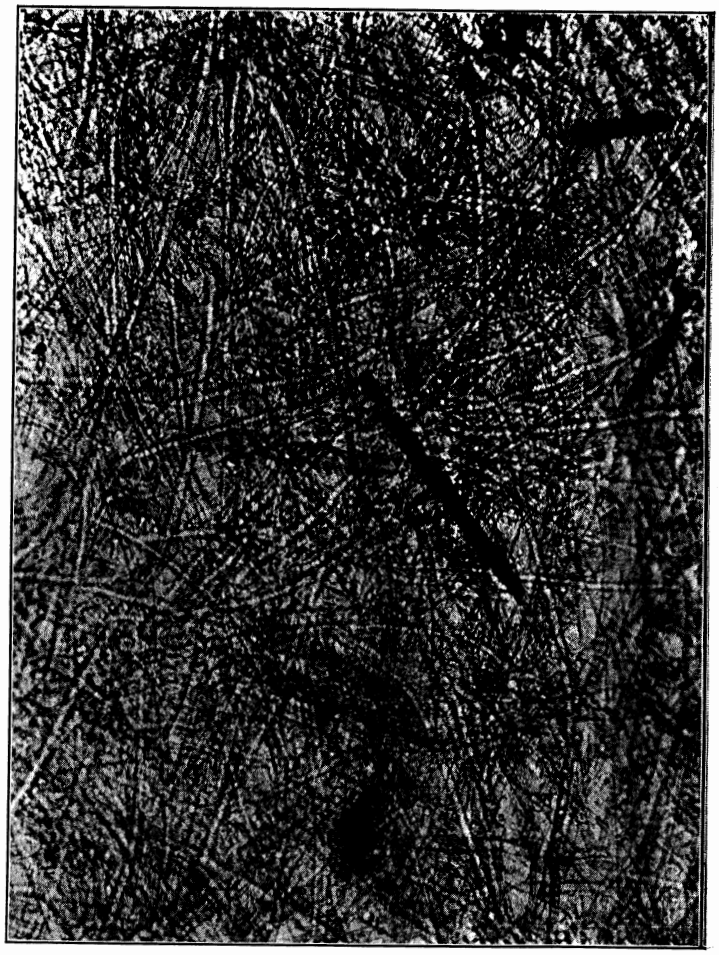


FIG. II. B.
SURFACE SECTION, FIBRES CLOSE, WELL PRESSED.

FIGURE II.

GENERAL DESCRIPTION :—a close, heavy, moderately calendered paper.

Thickness		$\frac{6}{1000}$ of an inch.
Fibrous compositions :	chemical wood	5 per cent.
	esparto	95 per cent.
Breaking weight machine way of paper		40.25 lb.
	cross direction	19.75 lb.
After folding, machine direction ...		24.5 lb.
Since this book showed the fibrous direction to be in the length way of the book, its strength after folding and piercing by needle was taken, and found to be		10 lb.

FIG. III. A.
TRANSVERSE SECTION.
AIR SPACE VERY LARGE.

FIG. III. B.
SURFACE SECTION.
FIBRES OPEN AND NOT PRESSED DOWN.

FIGURE III.

GENERAL DESCRIPTION :—a thick, bulky, feather-weight antique.

Thickness		$\frac{8}{1000}$ of an inch.
Fibrous composition :	chemical wood	50 per cent.
	esparto	50 per cent.
Breaking weight machine way of paper		18.3 lb.
cross direction		10.3 lb.
After folding and needle piercing		9.75 lb.

This is shown the strong way of the paper since its grain was across the pages of the book.

Breaking weight across the grain ...		7.5 lb.

FIG. IV. A.
TRANSVERSE SECTION.
AIR SPACE BETWEEN THE FIBRES LARGE.

FIG. IV. B.
SURFACE SECTION.

FIGURE IV.

GENERAL DESCRIPTION :—A feather-weight antique.

Thickness	$\frac{8}{1000}$ of an inch.
Fibrous composition : chemical wood	50 per cent.
esparto	50 per cent.
Breaking weight, machine direction	13 lb.
„ „ cross direction	10 lb.
After folding, breaking weight, machine direction	6.25 lb.
„ „ „ „ cross direction	4.5 lb.
Since the fibrous direction is across the page it shows tested with needle hole	6 lb.

FIG. V. A.
TRANSVERSE SECTION.

FIG. V. B.
SURFACE SECTION.

FIGURE V.

GENERAL DESCRIPTION:—A thin, esparto printing paper.

Thickness	$\frac{3.75}{1000}$ of an inch.
Fibrous composition: chemical wood	35 per cent.
esparto	65 per cent.
Breaking strain, machine direction	19.75 lb.
„ „ cross direction	6 lb.
After folding, machine direction	13.75 lb.
„ „ cross direction with needle hole	4 lb.

FIG. VI. A.
TRANSVERSE SECTION.
AIR SPACE VERY APPARENT.

FIG. VI. B.
SURFACE SECTION.
ESPARTO CHARACTERISTICS VERY MARKED.

FIGURE VI.

Thickness	$\frac{7}{1000}$ of an inch.
Breaking strain, machine direction	12.5 lb.
cross direction	6.5 lb.
After folding once,	
Breaking strain, machine direction	6 lb.
Pierced by needle, cross direction	2.75 lb.

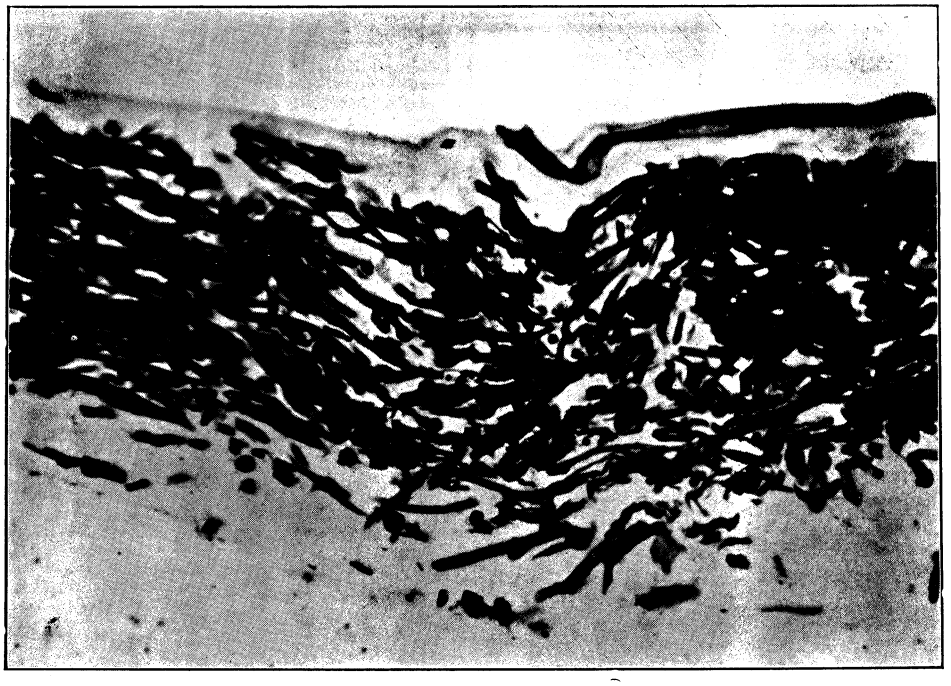


FIG. VI. C.

TRANSVERSE SECTION. FOLDED ONCE ONLY.

EFFECT OF CREASE IN FIBRE VERY MARKED.

The effect of folding on this paper, as seen in FIG. VI. C vividly illustrates what happens to much paper made recently. It looks as would a piece of wooden shaving folded once across the way of its grain. It is through this weakened fold that the sewing of books and their subsequent binding has had to depend for its value.

This should make apparent the necessity for revising the methods of bookbinding where a book requires to give the service of public use.

It is impossible to bind a book of such paper as above and give economical service, unless its qualities are known and methods of sewing and binding are carefully adapted to it. To bind this according to the ordinary library specification is to waste the resources of a library.

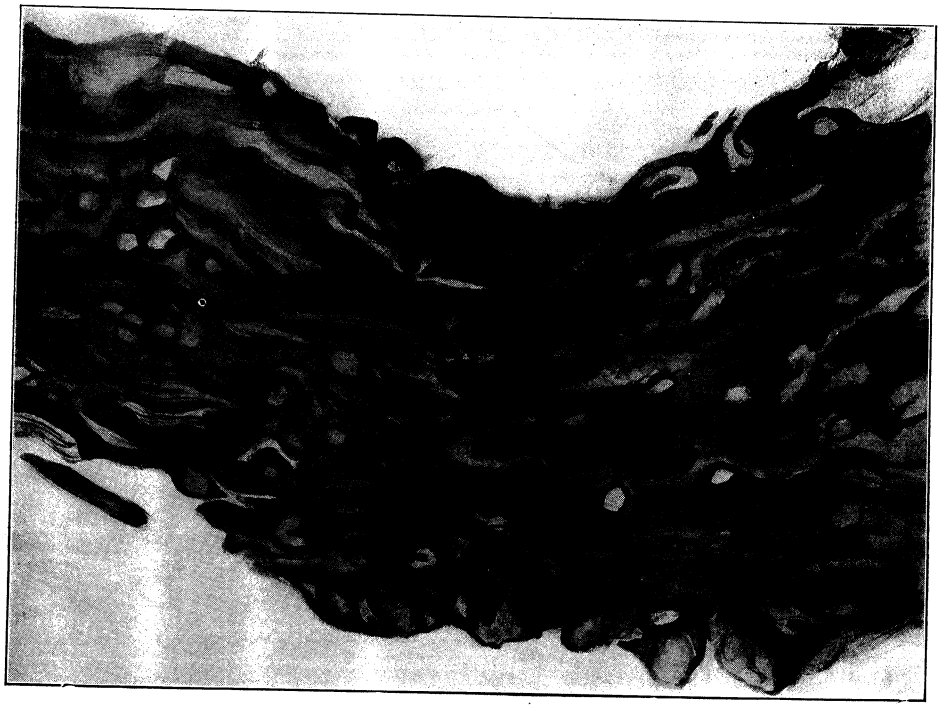


FIG. VII.

TRANSVERSE SECTION OF A PAPER FOLDED ONCE, THE QUALITIES OF WHICH ARE AS FOLLOWS:

Thickness	$\frac{10.5}{1000}$ of an inch.
Breaking strain, machine way of paper	38.5 lb.
cross direction	20.25 lb.
After folding, machine direction	22.5 lb.
" " " " pierced by needle	18.25 lb.
" " across the grain ...	13.75 lb.

This is a fairly good paper which, as the illustration shews, will stand folding and sewing through the fold in the manner in which books have until recent years been treated.

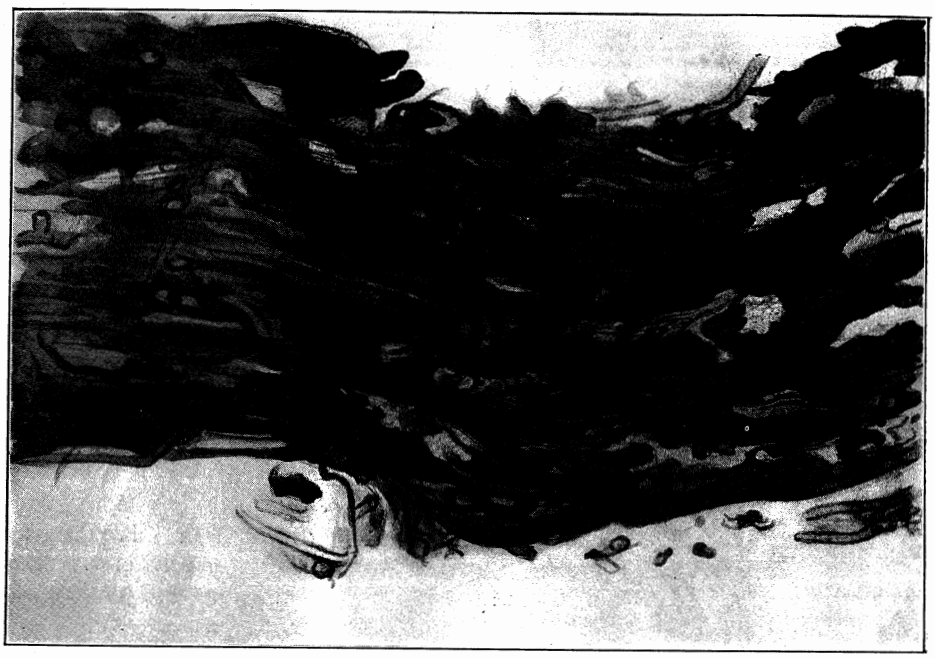


FIG. VIII.

TRANSVERSE SECTION OF PAPER AFTER ONCE FOLDING.

Thickness	$\frac{4.75}{1000}$ of an inch.	
Strength, machine way of grain	26	lb.
„ „ „ across the grain	15.3	lb.
„ after folding, machine direction	16.5	lb.
„ cross direction	10.0	lb.
„ after pierced by needle and folded in the machine direction	15.75	lb.

This is a good paper for which the ordinary methods of sewing will suffice, but it requires special treatment in the binding because of its thickness, as does also the paper shewn in FIG. VII.

LENDING v. REFERENCE BOOKS.

It should here be borne in mind that we are discussing only lending-library books, which require to serve some 150 to 200 issues during a life of from 3 to 12 years, and it is another question to determine the value and life of books made of this paper for the reference library. Here the mischief is greater and the ingenuity of the bookbinder is less effective.

To do good work and get efficient results the workman must have good tools and good materials. Now we cannot make good books of bad paper. We can take bad paper and make the best of it. First, however, we must know how good the bad paper is—that is, we have to discover what qualities of strength, pliability, and good surface the materials possess with which we have to deal.

It is necessary to arrange the field of inquiry. To make a beginning we limit this to books used in lending libraries. An inquiry into the chemical and fibrous composition of paper does not help much, so we set this on one side.

FIBROUS DIRECTION IN PAPER PULP AND THE VARIATION OF THE TENSILE STRENGTH OF ITS PAPER.

It appears necessary, however, to learn something about the grain or fibrous direction of the paper; also its strength both in this fibrous direction and across it. The strength of the paper under its condition arranged for binding, that is, the tensile strain it will stand when folded and pierced for oversewing; its thickness, and something of its surface and stiffness.

It is well understood that with machine-made paper the fibre is drawn in one direction, and that consequently paper is stronger when in one direction than in the other.

As the result of testing the paper of some five thousand books, an average difference in strength was discovered between the machine way of the paper and the cross direction of no less than 45 per cent.

THE FUTILITY OF THE LIBRARY SPECIFICATION.

It seems reasonable to assume that the binder having these facts before him would be better equipped to make a well-bound book than if, ignorant of these facts, he bound a book according to a specification drawn up by some one dead and buried years before the composition of the paper to be dealt with had been thought of, or a specification by a living person who has given no more attention to the composition of modern papers than his deceased confrère.

In a large number of libraries in Great Britain it is required that their books be bound to such a specification, and the custom is not unknown in America.

FIG. IX.

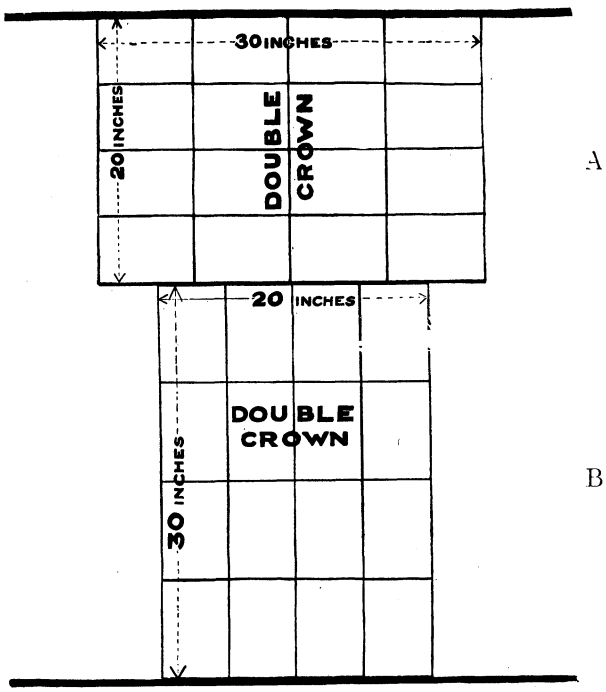


Figure IX. is the surface of a roll of paper, the width of which is indicated by the two thick lines.

A sheet of paper cut as the vertical form B would, when folded into 8vo, have the "grain" the same way as the type on the page, and the paper would be stronger in this direction than it would if cut as the figure with the form in the other horizontal direction A. This latter would be arranged when folded so that the fibrous direction would be up and down the page of the book and consequently it would be weak in the fold.

ENGLISH AND AMERICAN BOOK PAPERS.

Some two years ago my advice was asked in a matter of determining the best books for wearing qualities for a large library, and many hundreds of English and American books passed under my review.

It appeared to be generally considered that the paper of English fiction wore better than the paper of American fiction. This also had been my own experience. In handling the paper in order to determine this quality I had to decide in the "rule of thumb" fashion of handling it that in a very few cases did the English book show as superior in quality to the American book—that is, the substance and quality of the papers appeared equal, yet the general experience of the wearing qualities of the two papers constantly told that the English book was the better.

5000 BOOKS TESTED.

In testing the five thousand books mentioned above, the majority were English books, and the question of superiority of their papers came under review.

With 3717 English books 66 per cent. of the papers showed the grain to be across the page, that is in the strong way for binding.

Thirty-four per cent. of the papers exhibited the grain up and down the page, making the book weak in its fold for sewing.

With 981 American books 14 per cent. only were in the strong way of the grain, whilst no less than with 86 per cent. the grain of the paper was in the length of the book, and therefore the sewing was through the weakened fold of the leaf. This accounted for the facts observed.

FIG. X.

3717 ENGLISH BOOKS.

2444	Show the grain to be across the page.	66 per cent.
1273	Show the grain to be down the page.	34 per cent.

981 AMERICAN BOOKS.

135	Show the grain to be across the page.	14 per cent.
846	Show the grain to be down the page.	86 per cent.

The difference in the strength of the paper in one direction or the other being as much as 45 per cent., it is especially desirable to know of this fibrous direction with weak modern papers before proceeding to bind a book which is to be much used.

FIG. XI.

With 293 books most recently published at the time of writing, obtained for the purpose of a catalogue in compilation, the following data was obtained:

293 BOOKS.

	Machine way of Paper	BREAKING STRAIN OF PAPER.		
		Flat Piece of Paper	Paper folded	Paper folded and pierced once
24 of these books	WIDTH or strong way	397 lbs.	204 lbs.	188 lbs.

Showing a difference of 52 per cent in folding and piercing.

	Machine way of Paper	BREAKING STRAIN OF PAPER.		
		Flat Piece of Paper	Paper folded	Paper folded and pierced once
269 of these books	LENGTH or weak way	2215 lbs.	1429 lbs.	1283 lbs.

Showing a difference of 42 per cent in folding and piercing.

Were these 269 books the strong way of the grain as with the 24 books, their tensile strength would be 4449 instead of 2215 lbs., the loss is therefore 50 per cent, showing a total loss of more than 75 per cent.

	Thickness of Paper in thousandths of an inch	Oversewing Test
293 Books	1500 or about $1\frac{1}{2}$ inch, averaging $\frac{5}{1000}$ of an inch per paper.	1934 lbs. or an average of about 7 lbs. per paper.

With oversewing when properly done the paper is not weakened nearly as much. With the unfolded sheet pierced for oversewing the loss is only of 26 per cent as against 42 per cent to 52 per cent with folding and sewing. See Figure XI.

One other great advantage of oversewing papers suitable for the method is, that the paper is not doubled acutely and the fibre is not consequently broken as seen in the illustrations.

This will be understood on referring to Figure XIII.

A book sewed through the folded paper may serve well if the grain be across the page, but the same paper would make a weak binding if served in the same manner with the grain running the length of the book.

The bound book would, of course, experience no disadvantage if in the weak direction the paper remained sufficiently strong to hold the stitches under wear and tear, that is, if the margin of tensile strength either way of the paper were above the required tenacity.

THE LOSS OF PAPER STRENGTH IN THE ACT OF FOLDING.

Until recently paper was made of such consistency that it was of little importance which way of the grain the paper was folded. But library books are used and handled more in these days, and the more recent books are largely made of weaker paper. It is therefore now, as it has not hitherto been, of importance to discover these mechanical facts and to appropriately deal with books so printed.

The strength of the paper, both with and across its grain, having been ascertained, it is desirable to know its tensile strength when folded and pierced for the sewing. Examination and testing discloses extraordinary results.

THE LOSS OF STRENGTH IN PERFORATION BY NEEDLE FOR SEWING.

Leaves folded once only and pierced with a needle as for ordinary sewing show with modern papers an average loss in tensile strength when the grain was across the page of no less than 52 per cent. The loss was something less, as might be expected, when the fold was in the direction of the grain. Here the loss was 42 per cent. But it must be remembered that a leaf of paper with the grain running the way of the fold has already been shown to have lost 45 per cent. of its strength as compared with the same paper folded in the other direction. This is an *average* loss.

With very many books the loss is of course much more.

This weakened paper largely accounts for the disastrous results so frequently discovered with recent books which have been bound with care and good materials.

BAD QUALITIES OF MODERN PAPER NOT HITHERTO OBSERVED.

Even when thought is taken and the paper is examined by the ordinary method of handling it, its essential weakness above described escapes notice.

It is a fact not hitherto observed that modern papers lose so very large a proportion of their tensile strength in the acts of folding and sewing.

FIG. XII.

115 Books,

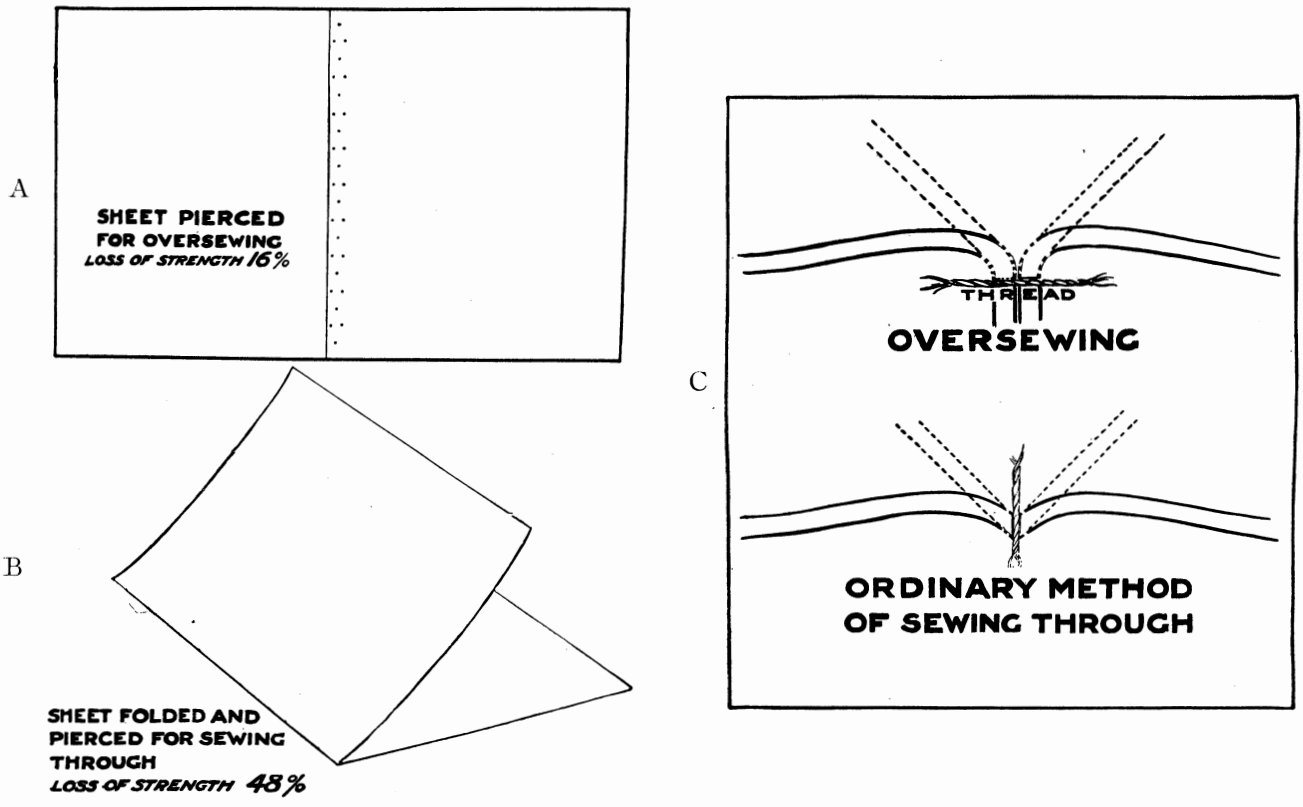
the productions of 24 Publishers.

Publisher.	No. of Books tested.	Strong way of grain.	Weak way of grain.
A	2	43.05 lbs.	26.5 lbs.
B	5	83.35	45.5
C	9	181.96	106.71
D	9	155.27	97.21
E	2	44.75	21.25
F	3	60.55	30.55
G	2	20.91	17
H	3	49.41	26.21
I	6	160.80	79.26
J	1	19.25	8.75
K	1	14.3	6
L	6	102.91	54.5
M	13	330.55	170.31
N	4	85.75	43.30
O	3	70.3	42.5
P	8	128.35	70.80
Q	4	61.8	34.35
R	1	20.5	12.66
S	6	113.82	67.25
T	2	12.75	12.25
U	1	17	9
V	11	152.03	85,30
W	9	149.87	91.96
X	4	71.25	33.75
	TOTALS	2159.48 lbs.	1192.87 lbs.

The above form sets out the stronger and weaker direction of the papers of 115 books, selected haphazard from the catalogues of twenty-four leading publishers.

The average difference with these 115 books between the strong and the weak way of their papers is seen to be **no less than 45 per cent.**

FIG. XIII.



STATISTICS SHOWING RECENT DETERIORATIONS.

We come, then, to the conclusion that when a book is made of paper the fibrous direction of whose grain is down the page, and it is folded and pierced for sewing, a loss of tensile strength ensues of not less than 75 per ct.

We have already seen that with 86 per cent. of American fiction the grain is in this weak direction.

The general deterioration of the paper used for fiction during the last twenty years appears from a number of tests made for the purpose of this article to be from 10 lbs. to 6 lbs. in tensile strength.

The more modern papers develop the added vice of losing more of their strength in the act of folding and sewing in the following proportions:—

Books printed before 1890, showing an average tensile strength of 10 lbs., lost 20 per cent. by folding and sewing. Books printed during the present and last year, showing an average strength of 6 lbs., lost 50 per cent.

This, however, does not tell the whole story, for we have now to deal with the thickness of the paper.

Here it will be readily seen that for a book $7\frac{1}{2} \times 5$ inches, the ordinary cr. 8vo. or 12mo, there is a thickness, if it can be discovered, appropriate to its size.

The aforesaid examples showed an average thickness of $\frac{4.5}{1000}$'' the thinnest being $\frac{3.8}{1000}$'' and the thickest $\frac{6.6}{1000}$'' This, then, would appear to be an appropriate thickness for the ordinary volume of fiction.

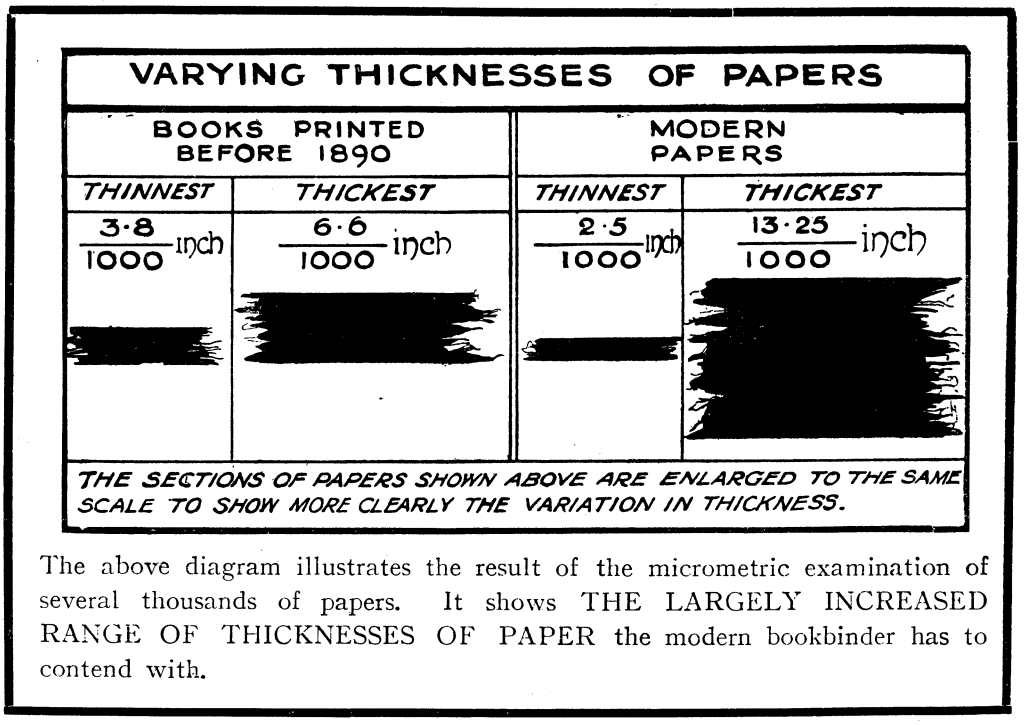
With 3069 books recently examined 1028 only were under $\frac{6}{1000}$ of an inch thick, while 2041 were over that thickness.

More modern papers show thicknesses from $\frac{2.5}{1000}$" to $\frac{13.25}{1000}$" with the largest proportion above $\frac{6}{1000}$".

Papers under $\frac{3.5}{1000}$" and over $\frac{7}{1000}$" in thickness and of the qualities under discussion would be badly bound if sewed in the ordinary fashion.

Out of a total of 3070 books there were 2377 outside these limits, so that because of the unsuitable thickness of their paper for a book $7\frac{1}{2} \times 5$ in.—apart from consideration of their tensile strength—2377 books out of 3070 would not be effectively bound if sewed through the folds in the ordinary manner.

FIG. XIV.



The above diagram illustrates the result of the micrometric examination of several thousands of papers. It shows THE LARGELY INCREASED RANGE OF THICKNESSES OF PAPER the modern bookbinder has to contend with.

With a collection of 700 recent books of fiction compiled during the last few weeks by the American Library Association as excellent from their literary value, the variations in thickness of their paper were from $\frac{2.5}{1000}$" to $\frac{13.25}{1000}$" with a large majority unsuitable in thickness for sewing advantageously in the ordinary manner through the fold.

It may be observed that the papers of the older books, 1890 and before, were only recently tested after in many cases years of arduous service, certainly losing much of their strength, while all the tests of more recent books were naturally of quite new paper.

GENERAL DETERIORATION OF PAPERS SINCE 1890.

Below is a rough comparison between the average book printed before 1890 with the paper issued during 1909:

FIG. XV.

A COMPARISON BETWEEN THE PAPER OF THE AVERAGE LENDING LIBRARY BOOK

	1890	1909
Tensile Strength	10 lbs	6 lbs
Loss in folding or sewing-	20%	50%
Of an undesirable thickness for binding in the ordinary way	5%	77%

THEREFORE:—

THE AVERAGE TENSILE VALUES OF THE PAPERS WHEN BOUND ARE AS FOLLOWS:—

1890——8 lbs 1909——3 lbs

The average thickness of paper for fiction before 1890 appears to have varied between $\frac{3{\cdot}8}{1000}$ in. to $\frac{6{\cdot}6}{1000}$ in.

Recent publications by the best publishers show as intimated a great variation in tensile strength. The table, FIG. XVII., shows under division of "strongest" and "weakest," those qualities in the papers recently used by 23 different publishers.

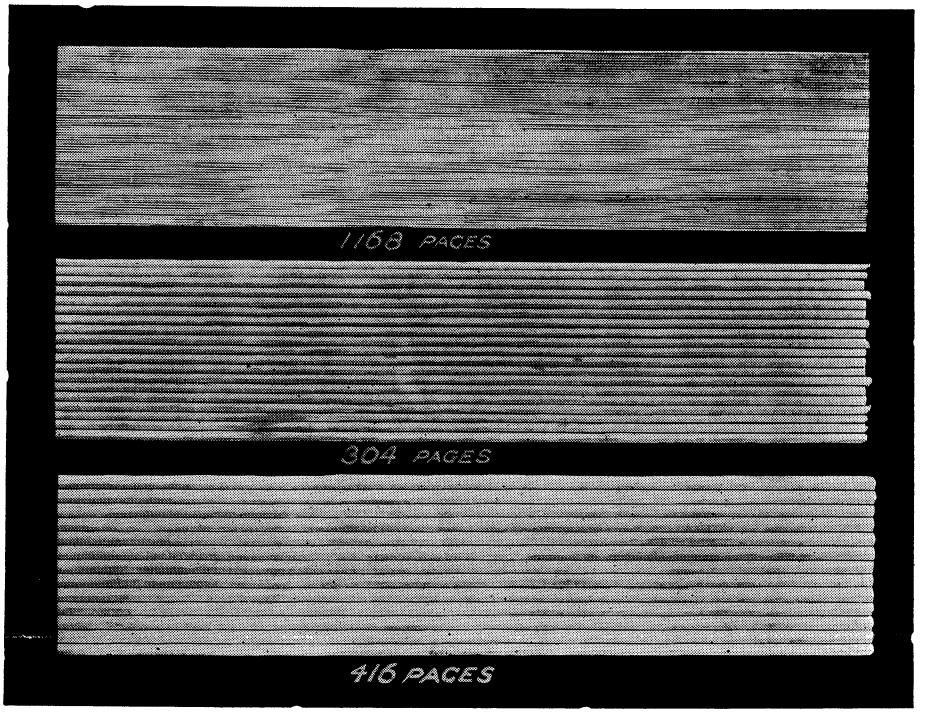
The first column under each heading shows the tensile strength flat, of an inch of each paper, the second column the tensile strength after being folded and pierced by the needle.

While it is true that a paper with its fibre running up and down the page is weaker in the fold for sewing, it is fortunately more pliable and falls over more readily in the hand when reading, so that if a book be carefully over-sewed, instead of sewing it through the folded section, a more pliable book is the result, and in most cases a stronger book.

FIG. XVI.

Apart from the problem of the thickness of Papers—THE VARYING NUMBER AND THICKNESS OF SECTIONS must be taken into consideration by the bookbinder.

THREE BOOKS 1⅛ inch THICK.



The illustration above represents the backs of three books folded and ready for sewing.

The	Top	Book	has	1168	Pages	and	is	composed	of	73	Sections of 16 Pages each.
,,	Middle	,,	,,	304	,,	,,	,,			19	,, 16 ,, ,,
,,	Bottom	,,	,,	416	,,	,,	,,			13	,, 32 ,, ,,

To bind these three books in the same way would bring about disastrous results.

It is obvious that DIFFERENT TREATMENT must be applied in each case.

CALENDERED PAPERS.

Another source of difficulty in dealing with modern papers is one which arises from the use of calendered and surface paper for illustrated books.

In their qualities of tensile strength and deterioration under folding and sewing they have been dealt with among the other papers in the books quoted above. But apart from their qualities in these respects they offer their own special problem.

Under the friction of use, when sewed and dealt with in the ordinary manner of bookbinding, the surface of the paper cracks away from its fibrous base and works itself into powder, together with the glue which has been used in lining its back. Losing the support of this gluten the weakened paper is held entirely, and more loosely by the sewing, and soon the leaves break away.

The varying thicknesses of this class of paper present also their special difficulties for solution.

VARYING THICKNESSES OF MODERN PAPERS NECESSITATE OTHER BINDING TREATMENT.

The bookbinder would wisely decide to oversew all the thinner papers of this class, while the thicker papers, if the book be of any value, should be dealt with by means of guarding. Even this more costly method can in some cases be made effective only by sewing as well as sticking on the attached jaconet joint, the surface of the paper offering the same difficulty to holding the guard, though in less degree, as it does in the binding of the book.

FIG. XVII.

PAPER USED BY 23 PUBLISHERS.

Publisher.	STRONGEST PAPER USED.		WEAKEST PAPER USED.	
	Breaking strain flat.	Folded and pierced.	Breaking strain flat.	Folded and pierced.
A	34.75 lbs.	16.5 lbs.	2.5 lbs.	1.3 lbs.
B	28	10.5	5.5	2.5
C	22	8.5	4.3	2.5
D	31.75	17.5	4	1.5
E	29	10.75	5.25	3
F	18.75	7.3	4.3	2
G	23.5	9.75	7	2
H	40	20	5	3
I	21	8.3	4	1.5
J	19	10.25	5	3
K	20.25	8	5	2.5
L	22.5	10	5.5	3
M	13	5.75	3.5	2
N	13.25	8	4	1.75
O	14.25	7	5.5	4
P	10	6.66	6.5	3
Q	17.25	4.5	5	2.5
R	17	8	7	4.25
S	14.25	7.75	9.25	5.25
T	9	5.5	5	2.25
U	10.25	6.5	6.5	4
V	11.25	8	3.5	2
W	30	16	12	8

RESULT OF BINDING IMPROPERLY ADAPTED TO THE QUALITY OF THE PAPER.

Figure XVIII. shows a book of antique feather-weight paper sewed and bound in the ordinary manner with a tight back. With usage the paper tends to swell in the back with the result seen.

If the nature of its paper were ascertained and it were appropriately bound, a long service might be obtained from this class of book.

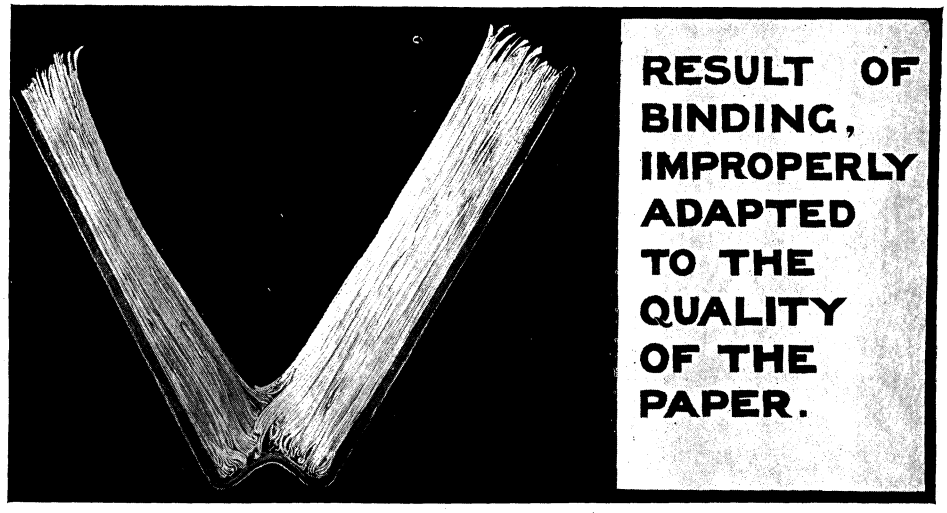


FIG. XVIII.

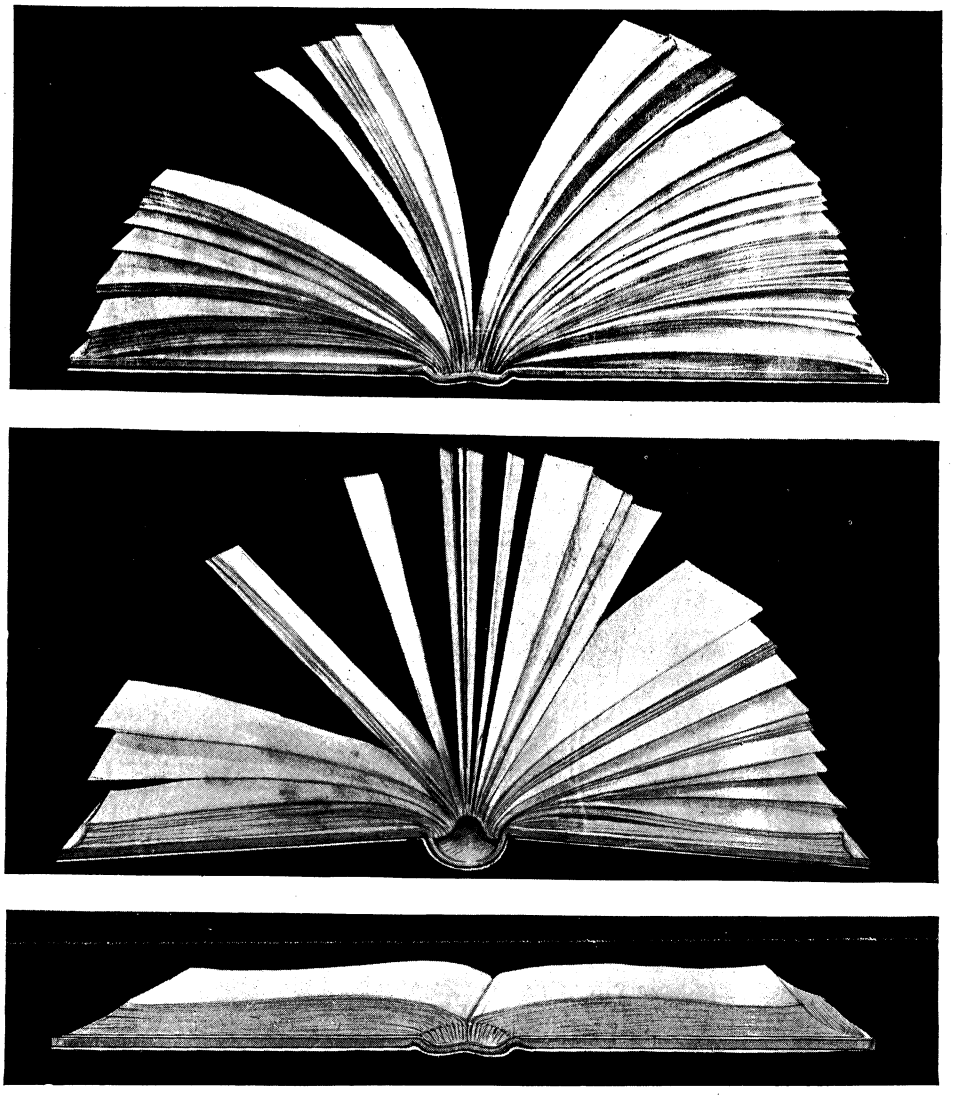
Fortunately there is very much that can effectively be done to remedy the faults we discover these papers to possess over those the bookbinding craft has been trained to deal with.

Figure XIX. is an interesting photomicrograph of the edge of a jaconet joint, with its cartridge paper guard, and a section of this calendered and surface paper under discussion.

The thick spongy nature of the guard and the two black sections of calendered surface, with the fibrous mass between are clearly shewn, while the cotton material making the joint has become detached in the handling necessary for microscopic mounting. The warp and woof of the jaconet is very apparent.

FIG. XIX.

FIG. XX.



A

B

C

Figures A and B are exact facsimile drawings from photographs of books composed of thick paper.

Either method of sewing with tight or loose back, as shown, is futile, while the plan seen in Figure C makes a perfectly bound book.

The leaves of the bottom book are each lined with a cotton hinge on a throw up guard.

It is absolutely necessary with many modern books to treat them in this manner. The cost is so little as to make the book an economical lending book.

COMPENSATIONS OFFERED BY SOME PAPERS OF BAD QUALITY.

The bookbinder may, if he makes himself cognizant of these facts now for the first time made known, and determines the tensile strength, together with the direction of the grain, turn these disadvantages into a desirable thing, for much of the paper here described possesses qualities of which he can take advantage. If it is thin it is at least pliable, and while it is impossible to sew it through the fold with profit, it may be carefully oversewed and last long enough for the librarian's purpose.

STOUT PAPERS MUST BE LINEN GUARDED.

If, as is very often the case, it is made into a thick sheet, it is impossible either to sew it through, because it is too brittle, or to oversew, because it is too thick and stiff. But its pulpy nature does allow of making it into a book advantageously by means of a linen guard. This method with ordinary paper would make an ugly, thick back. The soft, yielding nature of this paper under pressure makes way for the linen, and the result is a comparatively serviceable and good-looking book. (See Fig. 20).

With both these kinds of bad paper economical service can then be obtained.

COST OF THIS BUT LITTLE, SEE NOTE AT END.)

Having faced the difficulties he has experienced in the exercise of his craft, and learning their causes, the bookbinder is better equipped to deal with them. He must adapt his methods to what is practically the new material he has to bind, some of whose qualities are here discovered and made known.

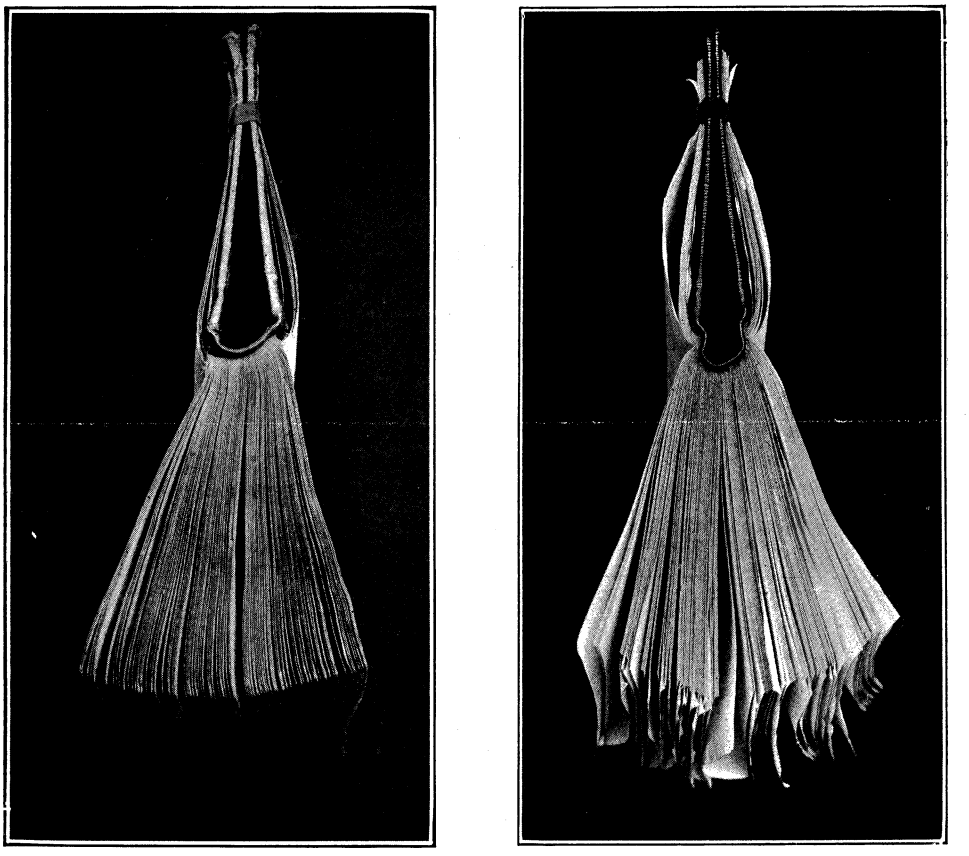
Figure XXI. is a graphic representation of the necessity of adapting the binding of books to the varying qualities of paper as here discussed.

Figure A is a book which has been 15 years in service and has been loaned 483 times.

Figure B is a book bound exactly in the same way and loaned some ten times only.

It would have been possible if the qualities of the paper had been ascertained, to have so bound it as to have insured for it as many loans as its paper would have sustained in a cleanly condition.

FIG. XXI.



A B

FIG. XXII.

981 BOOKS

Popular Fiction selected by a Committee of Public Librarians, the productions of 48 Publishers.

Publisher.	Number of Books tested.	Direction of Fibre.		Methods of Binding.						
		Width of Page.	Length of Page.	Style 1	Style 2	Style 3	Style 4	Style 5	Style 6	Style 7
A	107	2	105	79	...	21	...	3	1	3
B	154	16	138	115	...	28	2	7	2	...
C	120	12	108	60	1	41	7	7	4	.
D	106	32	74	85	1	5	3	10		2
E	60	11	49	45	..	9	1	1	3	1
F	33	...	33	24	...	2	1	6	...	...
G	30	1	29	20	...	7	...	2	1	...
H	30	2	28	20	...	6	1	1	2	...
I	29	3	26	27	...	1	.	...	...	1
J	27	6	21	18	...	4	1	4	...	...
K	27	4	23	26	...	...	...	1	...	...
L	44	13	31	37	...	3	...	2	2	...
M	21	1	20	21	...	...	...	...	...	...
N	16	1	15	12	...	4	...	...	...	...
O	14	4	10	12	...	2	...	...	...	...
P	10	...	10	10	..	...	...	...	...	...
Q	23	1	22	20	...	3	...	...	...	...
R	14	2	12	10	..	4	..	...	...	...
S	7	2	5	4	1	1	..	1	...	...
T	7	2	5	7	...	...	...	...	...	...
U	4	...	4	3	...	1	...	...	..	...
V	43	1	42	42	...	..	1	...	...	...
W	5	4	1	1	....	...	...	4	...	...
X	6	...	6	6	...	..	...	...	...	...
Y	5	...	5	5	...	...	..	...	...	...
Z	3	...	3	3	...	...	...	...	...	...
a	3	2	1	3	...	...	...	...	...	...
b	3	2	1	3	...	...	...	...	...	...
c	2	1	1	2	...	...	...	...	...	...
d	2	2	...	2	...	...	...	...	...	...
e	2	1	1	1	...	...	...	...	1	...
f	3	...	3	2	...	1	...	...	...	...
g	2	...	2	2	...	...	...	...	...	...
h	2	2	...	2	...	...	...	...	...	...
i	2	...	2	1	...	...	...	1	...	..
j	1	1	...	1	...	..	...	...	...	...
k	1	...	1	1	...	...	...	..	...	...
l	1	...	1	1	...	...	...	...	..	...
m	1	.	1	1	..	...	...	...	...	...
n	1	1	...	1	...	...	...	...	...	...
o	2	1	1	1	...	1	...	...	...	...
p	1	..	1	1	..	...	...	...	...	...
q	2	1	1	2	...	...	...	...	...	...
r	1	1	...	..	...	1	...	...	...	...
s	1	...	1	1	...	..	...	...	...	...
t	1	...	1	1	...	...	. .	...	...	...
u	1	...	1	...	...	1	...	...	...	...
v	1	...	1	1	..	...	...	..	...	...
Totals	981	135	846	743	3	146	17	50	16	7

Here are displayed 981 books supplied by 48 different publishers. They have been selected as the most popular fiction in use in America by a Committee of Public Librarians.

846 books were made of paper the fibre of which was in the wrong way. 135 books were made of paper in the strong way of its fibre.

The other divisions of style show in the judgment of the writer, the seven chief methods of binding which should be adopted to ensure efficiency.

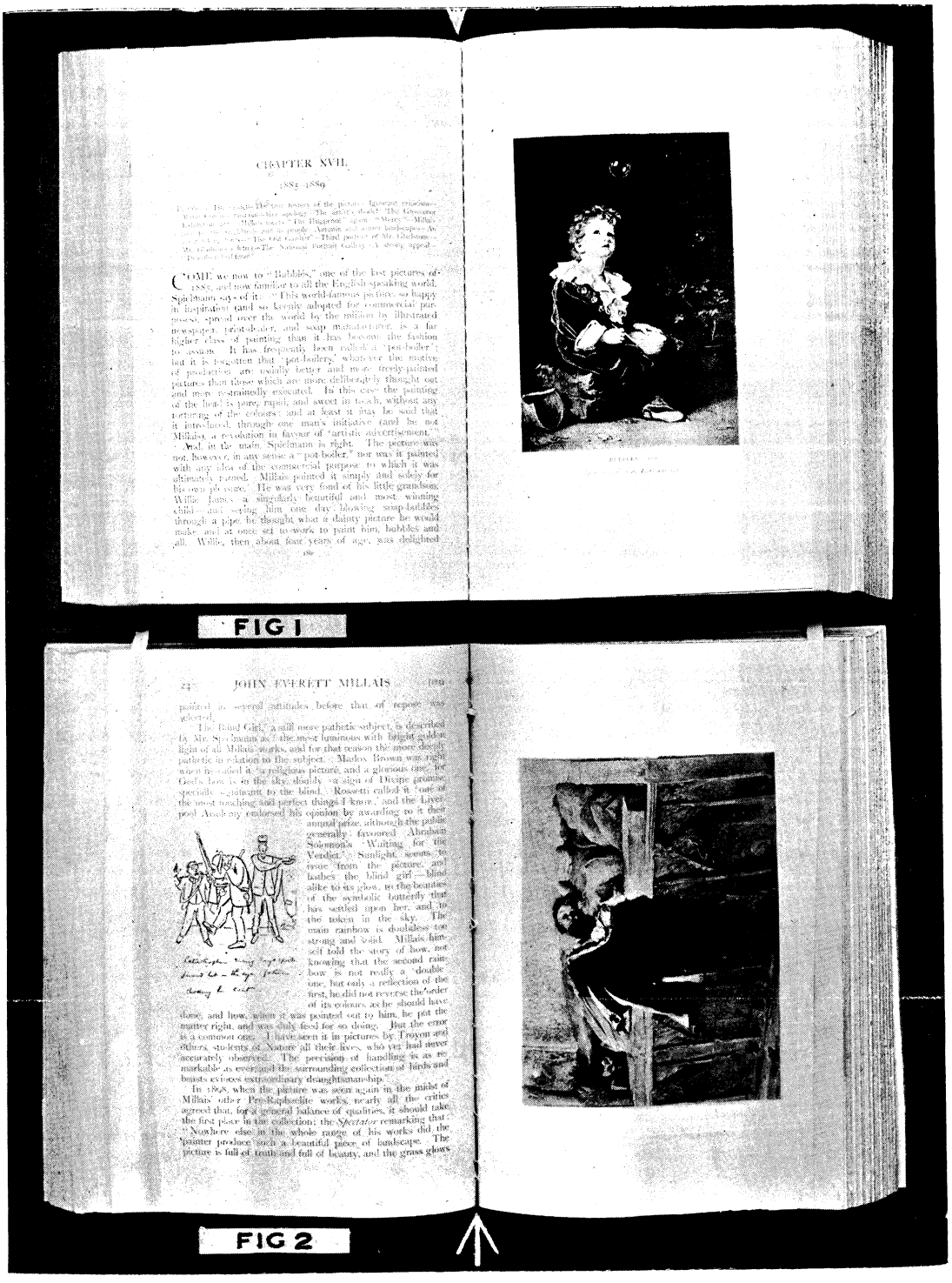
Style 5 represents the method usually described with the ordinary library specification to be sewed through the section, and for this style of work fifty books only would be suitable.

Style 1 is the fashion in which no less than 743 books out of 981 should be done, and they should all be oversewed. The paper with all these 743 books is unfit to sew through in order to withstand the strain of public library work.

The leaves of the other books should be strengthened by jaconet in various ways, or the leaves must be dealt with singly by means of mounting on a guard with a jaconet hinge or joint. This must be done in order to obtain reasonable usage with these books.

FIG. XXIII.

DESIRABLE OVERSEWING.



IMITATION OVERSEWING.

The above are photographs of two books open to shew the oversewing of each.

Fig. 1 shews the regularity necessary to proper oversewing, and the consequent strength of the work may be inferred. There are no less than 36 stitches in sight.

Fig. 2 (an imitation of the above) shews only 13 stitches, and those irregularly done, subjecting the leaf to strain and tear.

The books are two copies of the same publication.

NOTE.

It is within the capacity of the bookbinder equipped with this knowledge of the qualities of paper, so to deal with the books of the modern lending library as greatly to increase their service.

With many qualities an expenditure of 1d., 2d. or 3d. in the right place will increase the life of the book 50 per cent. saving as many shillings, and with the thicker featherweight and calendered papers the extra cost of linen-guarding (from 7d to 9d. for a 200 page book) will ensure a saving of 200 or 300 per cent. One book may be made to serve more agreeably to the reader and with more satisfaction to the Librarian, where two or three books were successively required before.

It is impossible for the bookbinder to give these results if his method of binding is prescribed for him. It is here seen that books vary too much—in tensile strength, in thicknesses of paper, in thicknesses of section, in loss of strength in folding and sewing, in brittle and in friable qualities to allow of binding to a specification. He can only bind well if he binds books according to the needs of their papers.

The only possible test of good bookbinding is to watch its record of service and judge by results. When the guardians of books will take this trouble, and insist on assuming these responsibilities and declining such as they now are unable, but are expected to perform, the Institutions they serve will reap rich results. Such economies will be effected as will enable them for the same expenditure largely to increase their usefulness by having better looking books, more serviceable books' and more books.